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ABSTRACT

The Ohio Skill Gap Initiative was conducted to determine the following: (1) what foundational skills--and skill levels--do entry-level employees need to succeed in today's workplace and (2) whether the students graduating from Ohio's public schools possess the foundational skills that will permit them to acquire the knowledge and "know-how" needed for successful entry into and advancement through the present and future workplace. The Ohio Skill Gap Initiative used ACT's "Work Keys" system to answer both of these questions. Jobs in ACT's national database that most closely matched the skilled entry-level jobs that will exist in Ohio's future economy were selected for the study. Data were gathered in four areas (applied mathematics, reading for information, applied technology, and locating information) through Work Keys assessments administered to 14,474 high school seniors at 119 schools. Findings were as follows: (1) Ohio has a significant skill gap; (2) college-bound students are well prepared for jobs requiring a high school education, but students who are not college bound are not; (3) jobs in scientific fields call for much higher skill levels than do clerical or customer-service jobs; (4) the skill gap is greatest where the skill is not included in the students' curriculum (applied technology and locating information); and (5) suburban and rural students showed higher skill levels than urban students. Recommendations were made for actions by educators, employers, parents, communities, and public officials. (KC)

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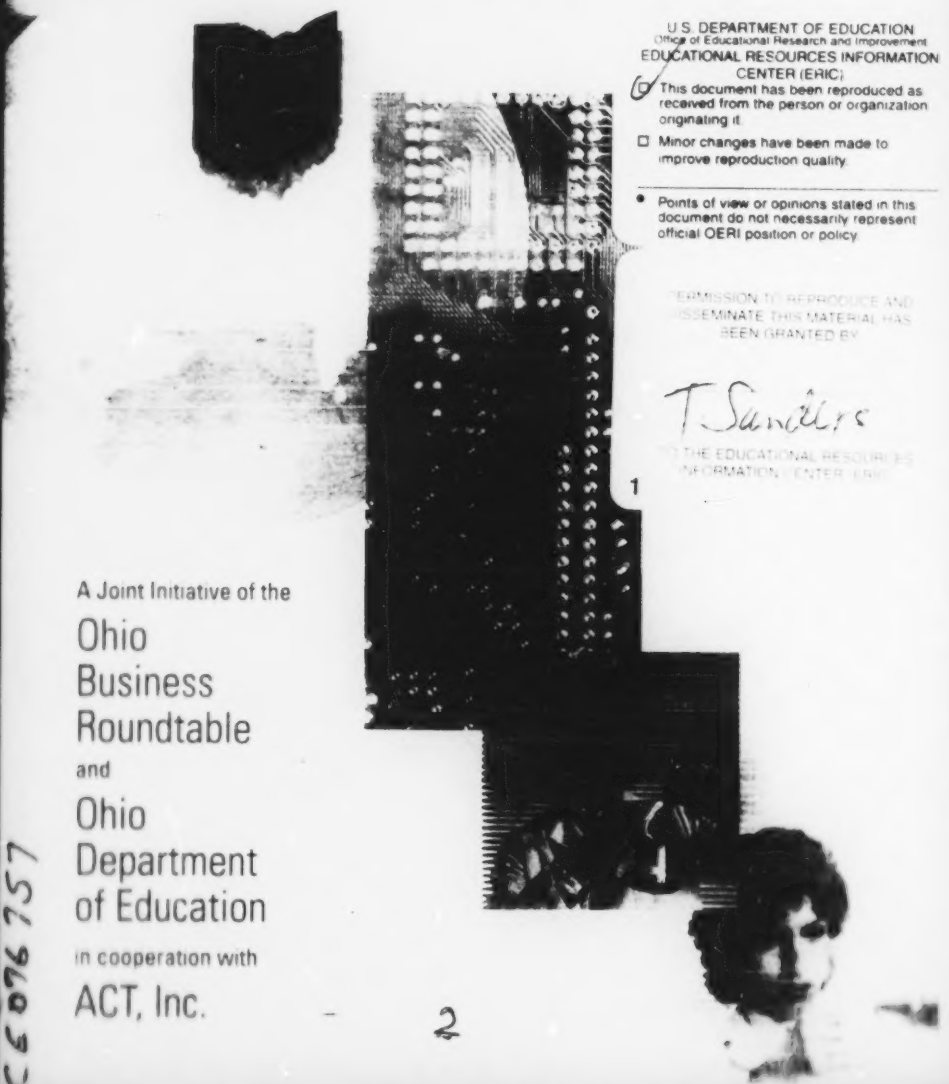
...ledge & Know-How

Meeting Ohio's Skill Gap Challenge



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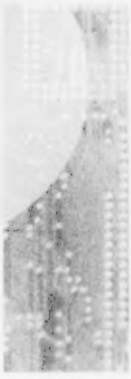

Meeting Ohio's Skill Gap Challenge

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June 1998

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Today, Ohio has a significant "skill gap." We are preparing too few students to meet world-class standards in core academic subjects, and too many students are leaving high school unprepared for productive work and effective citizenship. Our economic security — and our ability to flourish as a democratic society — demand a generation of high school and college graduates with the knowledge and know-how to succeed in the 21st century.

INTRODUCTION

Ohio's Greatest Challenge

For most of the 20th century, Ohio's industrial economy offered secure employment and good wages to vast numbers of high school graduates — as well as many who did not complete high school. Because most jobs required only basic levels of skill, all but the most undereducated citizens could find employment that enabled them to support their families.

But Ohio's economy has changed dramatically during the last two decades of the 20th century — and even greater changes are on the horizon.

Ohio's new economy — characterized by unprecedented technological advances, rapid change, intense competition, and high standards of productivity and innovation — is creating sweeping changes in workplace demands. Throughout the state, low-skill jobs are disappearing and the need for well-educated, knowledge-based workers is increasing.

Today, understanding and applying written and visual information, mastering new technologies, and using mathematical reasoning in solving problems are becoming *fundamental* workplace skills — even in many entry-level jobs. Every employee's ability to locate information, anticipate and prevent problems, redesign inefficient work processes, and function as a team member is a competitive asset.

Many employers are administering a battery of academic tests to prospective employees — not passing means no job. In other words, more Ohio workers than ever before are expected to **think for a living**.

Unfortunately, however, the *skills* of Ohio's emerging labor force do not match the current *skill demands* of Ohio's workplaces. Too many job candidates are unable to read instruction manuals, complete simple forms, or apply fundamental mathematical and scientific principles to work-related problems. Too many Ohio companies are spending valuable training dollars on basic reading and mathematics skills for their workers. Too many Ohio communities lack enough skilled workers to attract new businesses. This "skill gap" is Ohio's greatest economic challenge, and it is a challenge that is shared by Ohio's business and education communities.

Closing Ohio's Skill Gap

The challenge of closing Ohio's "skill gap" includes providing high school students—and learners already in the workplace—with more and better options for specialized career training. But an even larger area of concern is the need to ensure that all high school graduates have acquired the foundational skills needed for future success in *learning* to do the work they choose to pursue.

In other words, improving the foundational skills of Ohio's future workforce means increasing the number of students who graduate from high school academically prepared to continue learning — whether in an educational setting or in the workplace. Every high school graduate should have *at least* the fundamental knowledge and skills in mathematics, technology, and written and visual communications that are needed for entering postsecondary education or learning to perform a challenging entry-level job and work as a productive member of an organization.

We know ***why*** we need to close the skill gap — our short-term and long-term competitiveness and economic prosperity are at risk. We know ***how*** to close it — through rigorous, relevant academics augmented by opportunities for hands-on learning, technology training, and experiences that prepare students to be effective team members, leaders, and lifelong learners. We know ***who*** shares the responsibility for creating these new learning opportunities — educators, parents, employers, labor, and public officials, equally. And we know ***when*** we have to get the job done — the future is now.

But to develop truly responsive approaches to preparing students for future career and educational challenges, we still need to determine ***what*** specific skills — and skill levels — are falling within the skill gap. For this reason, the Ohio Business Roundtable and the Ohio Department of Education, in cooperation with ACT, Inc., launched the Ohio Skill Gap Initiative.

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The Ohio Skill Gap Initiative

The goal of the Ohio Skill Gap Initiative was to answer two fundamental questions:

1. What foundational skills — and skill levels — do entry-level employees need to succeed in today's high performance workplace?

2. Do the students graduating from Ohio's public schools possess the foundational skills that will permit them to acquire the knowledge and know-how needed for successful entry into — and advancement through — the present and future workplace?

The Ohio Skill Gap Initiative used ACT's ***Work Keys***® system to answer both of these questions. Work Keys was selected for the study because it is a credible, reliable, and convenient measuring tool already being used by educators and employers in Ohio and across the nation.

To help determine the needs of Ohio employers, this initiative focused on two types of information about the skilled entry-level job opportunities that are characteristic of Ohio's future economy:

- Requirements for general foundational skills, such as reading, solving mathematical problems, or applying the principles of physical science.

- Requirements for specific skill levels — from basic skills, such as making change or using basic tools, to more complex skills, such as analyzing statistical data or understanding the operation of complex machines.

As a basis for targeting desired skill levels, the jobs profiled in ACT's national database were analyzed. Those that most closely matched the skilled entry-level jobs that will exist in Ohio's future economy were selected for use in the Ohio Skill Gap Initiative. These jobs were grouped into five categories, or job clusters, and average skill levels were determined for each cluster.

To better understand the skill levels of Ohio students, Work Keys assessments in four areas were administered to a sample of more than 14,000 Ohio high school seniors. These assessments measured generic skills in reasoning, interpreting information, and problem solving that are common to virtually all jobs.

The results of this analysis are the subject of this brief report, which is designed to focus employers, educators, parents and public officials on actions that will be required to close Ohio's skill gap — and to ensure the future competitiveness of Ohio business.

Identifying Critical Work Skills

Each year, approximately 50,000 youth enter Ohio's workforce without any training beyond high school. An estimated 30,000 more young Ohioans fail to complete high school. For decades, this was not a matter of great concern, since American products dominated most markets and the nation's industrial economy provided steady work and decent wages to all but the most unskilled workers.

That promise no longer exists. Today, businesses require more advanced technical skills and expertise from their workers. To remain competitive in global markets, they demand it. And young people who are not equipped to succeed in these competitive markets — because their reading, writing, listening, math, and applied technology skills do not match the skill demands of the available jobs — increasingly find themselves out of work and out of luck.

In this context, two sets of facts are important. First, in 1950 an estimated 60 percent of jobs were "unskilled," and for these jobs at that time a high school diploma was optional. Now, as we begin to enter a new century, the demand for "unskilled" workers is estimated at 15 percent. A high school diploma is no longer optional; it is required for those jobs. The shift has primarily been to the need for skilled workers, those who have an Associate Degree, or some form of certification in a technical area. Sixty-five percent of jobs now require an associate degree, certificate, or apprenticeship.

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Second, it is interesting to note that the proportion of Ohio's high school graduates who go on for ***any*** college education is relatively low. According to ACT, approximately 65 percent of the nation's high school graduates go on to some form of higher education. In Illinois, 69 percent go to college. In Michigan, it is 68 percent. In Kentucky, it is 65 percent, while in Wisconsin and Iowa, it is 64 percent. In Ohio, the number is just 60 percent.

While it is not the focus of this report, it is clear that this pattern of advanced education is a concern for Ohio employers and citizens. Furthermore, this concern is enhanced by the fact that only about one third of Ohio's high school graduates complete what is generally considered to be a college preparatory program — i.e., four classes in English, and three classes each in math, science and social studies.

KEY QUESTION:
What foundational skills — and skill levels — do employees need for success in today's high performance workplace?

The Skill Gap Initiative's first phase produced a description of important skills students need for success in five different job clusters that generally reflect Ohio's current and future employment picture. This description is not based on the entire range of skilled jobs in each career area, and it does not capture all the skills a student would need for job success. It does make it possible, however, to set a common reference point for measuring some significant areas of performance and to establish a common language for discussing career patns, skills, and skill levels.

The Skill Gap Initiative completed this analysis of critical work skills using a four-step process designed by ACT:

Step 1 Selecting four skill areas to be assessed

Step 2 Selecting job profiles from ACT's database that reflect Ohio's present and future labor market needs

Step 3 Grouping job profiles into job clusters

Step 4 Determining required skill levels

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Step 1: Selecting Four Skill Areas

Four skill areas, reflecting the core requirements found in most workplaces, were selected for use in the Ohio Skill Gap Initiative:

Applied Mathematics: Skill in applying mathematical reasoning to a variety of work-related problems.

Reading for Information: Skill in reading and understanding written work-related instructions and policies.

Applied Technology: Skill in solving problems of a technological nature, such as applying principles of mechanics, electricity, thermodynamics, or fluid dynamics to machines and systems.

Locating Information: Skill in interpreting and using workplace graphics, such as diagrams, floor plans, tables, forms, graphs, charts, and instrument gauges.

There was some discussion as to whether to include Applied Technology in the study. The Applied Technology assessment focuses on the application of principles of physical science in the workplace. While many occupations require this skill, most high school students do not study physical sciences, physics, or other technology-related skills in their course work. As a result, it was expected that the scores in this skill area would be low. Based on the belief that these are important workplace skills and should be included in the high school curriculum, it was decided to include this assessment in the set.

These four skill areas form the basis of efforts by the Ohio Skill Gap Initiative to assess the skills of Ohio high school students. For each of these skill areas, the Work Keys system provides an assessment that measures student performance across a range of related skills, thus providing a picture of each student's overall level of skill and a basis for comparing the skill levels of different students.

Step 2: Selecting Job Profiles

The Ohio Skill Gap Initiative selected a number of ***job profiles*** that most closely matched Ohio's present and future needs for skilled entry-level workers. Available through the Work Keys system's database, these job profiles describe key skills and skill levels required for successful performance in specific occupations.

To target jobs offering security and growth potential, the Ohio Skill Gap Initiative used the ***Dictionary of Occupational Titles*** (DOT) and information from the U.S. Bureau of Labor. ***Each occupation selected for the skill gap study requires at least a high school diploma, has a median annual salary of at least $15,000, and is projected to show a growth rate of 10 percent or more through the year 2005.***

In general, the jobs selected do not require extensive postsecondary schooling. Jobs requiring low skill levels were not selected because these jobs are likely to be low-wage jobs that may well disappear in the years ahead — moving to places where the prevailing wage rate is lower. Additionally, low-growth jobs that are likely to be eliminated or low-wage in ten years were deleted from the study.

ACT's Work Keys occupational profiling procedure is designed to develop accurate profiles through a systematic task analysis that is performed by individuals who have experience in employment and testing. ACT trains these profilers and provides them with software to assist and document their profiling activities.

Profilers observe and meet with job incumbents — and in some cases job supervisors. First, they determine an occupation's most important tasks. Then, for each task, they identify the skills in each of the eight skill areas and skill levels required for effective performance.

Step 3: Grouping Job Profiles Into Job Clusters

Each of the occupations targeted in Ohio's Skill Gap Initiative belongs to one of five job clusters containing a range of jobs with similar work tasks. These job clusters, accompanied by *examples* of jobs they include, are:

Business Contact/ Operations Cluster
Sales clerk
Customer service representative
Administrative clerk
Medical records technician
Bank teller
Credit authorizer
Shipping clerk

Social Service Job Cluster
Medical laboratory assistant
Physical therapist assistant
Vocational training instructor
Cosmetologist
Hospital food service worker

Technical Job Cluster
Automobile mechanic
Electrician
Refrigeration mechanic
Plastics fabricator
Robotic machine operator

Science Job Cluster
Avionics technician
Quality control technician
Emergency medical technician
Surgical technician

Arts Job Cluster
Color printer operator
Graphic designer
Illustrator

Currently, these job clusters provide only a partial picture of present and future jobs. The Technical cluster represents a high number of jobs and a fairly balanced range of skill requirements. In contrast, the Arts cluster represents only a small number of jobs, and the Social Service cluster represents such a highly diverse range of occupations that it is more difficult to generalize about its required skill levels. In addition, not all job clusters reflect the full range of skill levels that exists in the actual job market.

Despite these limitations, these five job clusters provide a basis for defining the relative skill requirements for five major career directions open to Ohio students.

Step 4: Determining Required Skill Levels

Within the context of the job clusters and skill areas identified above, the Ohio Skill Gap Initiative used job profile data to determine what Ohio workers must know and be able to do. In the case of Reading for Information and Applied Mathematics, required skill levels range from 3 (the lowest level required for any job cluster) to 7 (the highest required level). For Applied Technology and Locating Information, the skill levels range from 3 to 6.

What do these skill level requirements tell us about what Ohio's new workers must know and be able to do? Table 1 provides a comparison of the skills required at the lowest and highest levels.

TABLE 1 COMPARISON OF SKILL LEVELS

	Lowest Level Skills (Level 3)	**Highest Level Skills** (Level 6 or 7)
Applied Mathematics (Applying mathematical reasoning and problem-solving techniques to work-related problems)	• Deal with simple mathematical operations such as calculating change or adding together the price of several products.	• Convert between measurement systems involving fractions, mixed numbers, decimals, and percentages. • Calculate areas and volumes of shapes. • Set up and manipulate complex ratios and proportions.
Reading for Information (Reading and understanding work-related information)	• Handle short, simple reading material with elementary vocabulary, such as straightforward memos or instructions.	• Deal with very detailed material, such as excerpts from regulatory and legal documents. • Apply general principles to new and somewhat dissimilar situations.
Applied Technology (Solving problems of a technological nature using the basic principles of mechanics, electricity, and fluid dynamics as they apply to equipment found in the workplace)	• Apply elementary physical principles, such as the use of heat to expand and loosen a metal nut stuck to a bolt. • Understand the operation of basic hand tools, simple machine components, and simple systems.	• Solve more complicated problems, often applying principles that affect certain properties of a system such as phase change or pressure equilibrium.
Locating Information (Using information presented in workplace graphics, such as charts, tables, diagrams, and instrument gauges)	• Use simple order forms, bar graphs, tables, flow charts, and floor plans. • Find pieces of information in elementary graphics. • Fill in missing information in a graphical presentation.	• Use complex graphics with a great amount of information. • Use graphics to draw conclusions. • Apply graphical information to situations.

Among the five job clusters, required skill levels vary considerably. Using an ***80 percent requirement***, which represents the skill levels required to qualify for 80 percent of the jobs available in each cluster, Table 2 shows this diversity. This standard tells us, for example, that if there are 20 job opportunities in a particular job cluster, a student who meets the 80 percent requirement would have the skills needed to qualify for 16 of the 20 jobs.

Therefore, Table 2 responds directly to the first key question addressed by the Ohio Skill Gap Initiative — i.e., what foundational skills, and skill levels, do employees need for success in today's high performance workplace? Intermediate skill levels are required for 80 percent of the jobs in most areas. Not surprisingly, 80 percent of the jobs in the Science job cluster require high level skills in Reading for Information and Applied Mathematics. In contrast, 80 percent of the jobs in the Business Contact/Operations and Arts clusters require substantially lower levels of skill in Applied Technology. It is also noteworthy that the overall occupational requirement for Applied Technology is only Level 4 — lower than for each of the other three skill areas. In part, this reflects the job profiling that has been conducted on various occupations to date by ACT.

TABLE 2 OHIO'S SKILL LEVEL REQUIREMENTS

Job Clusters	Applied Mathematics (Range: 3-7)	Reading for Information (Range: 3-7)	Applied Technology (Range: 3-6)	Locating Information (Range: 3-6)
	SKILL LEVEL REQUIRED FOR 80% OF AVAILABLE JOBS			
[illegible]	5	5	4	5
[illegible]	5	4	5	5
[illegible]	7	6	6	6
[illegible]	6	5	4	5
[illegible]	6	6	5	5
Overall Requirement	5	5	4	5

Assessing Critical Skills Among Ohio Students

To determine the skills of Ohio students, a sample of the state's public high schools was asked to administer four Work Keys assessments — Applied Mathematics, Reading for Information, Applied Technology, and Locating Information — to their seniors. In all, more than 200 Ohio high schools were contacted jointly by representatives of the Ohio Department of Education and the Ohio Business Roundtable, and a total of 143 administered the tests in November 1996. After 24 schools were dropped from the study because of irregularities in their test administration, the final sample consisted of 14,474 students at 119 schools.

To ensure that the sample sufficiently represented a cross section of Ohio's urban, suburban, and rural districts, selection of the students to participate was done by school rather than by individual student (stratified cluster sampling). The differentiation between suburban and rural schools was based on where the school was located, using definitions provided by the U.S. Bureau of the Census. Urban schools were selected from among Ohio's 21 urban districts as previously defined by the Ohio Department of Education. (See Appendix A for a detailed description of the sampling methodology.)

The tests were administered using a strategy called "spiraling," in which the tests are organized so that the first student in a group receives test A (for example, Applied Mathematics), the second gets test B (perhaps Reading for Information), and so on. When one of each test has been handed out, in this case four different tests, then the spiral is repeated.

This strategy works when, as with these tests, all of the tests have the same time limit. Using the spiraling strategy, one of the four Work Keys tests was administered to each senior at each school. As a result, each test was administered to more than 3,500 students with every school in the sample represented.

Since the only seniors not required to take the test were those whose Individual Education Plans exempted them from proficiency testing, the seniors who took the test reflected the existing distribution of students among college prep programs, vocational education programs, and gifted education programs. As a financial incentive to students, the Ohio Business Roundtable awarded a $100 U.S. Savings Bond to one randomly selected student for every one hundred students taking the test – with at least one bond awarded in each participating high school.

KEY QUESTION:

To what extent do the students graduating from Ohio's public schools possess the skills needed for successful entry into — and advancement through — the present and future workplace?

In the WorkKeys assessment system, each skill area is independent of the others. Performance on these assessments is reported as "levels." For the skills used, the lowest reported level is 3, and the highest level is 7 for Applied Mathematics and Reading for Information, or 6 for Applied Technology and Locating Information. Students who are not able to score at the minimum (Level 3) are reported as being "Below Level 3." Table 3 shows the percentage of students who scored at each level in each skill area.

TABLE 3 OHIO STUDENT ASSESSMENT RESULTS

Level	Applied Mathematics	Reading for Information	Applied Technology	Locating Information
7	6%	4%	NA*	NA*
6	21	22	0%	0%
5	29	32	4	19
4	25	33	12	55
3	14	5	30	18
Below 3	5	4	54	8

* Not applicable

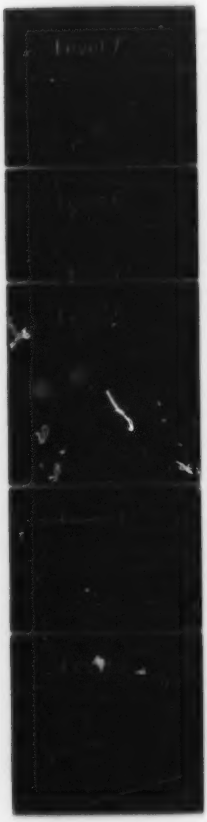
In each skill area, Level 3 was set at the lowest level employers valued for their jobs. Therefore, students scoring below Level 3 are considered not to have the necessary level of skill for any job that requires that skill area. This means, for example, that 4 percent of Ohio seniors would not qualify for ANY job that has reading for information skill as a job requirement. Beyond this, each skill level has its own definition and characteristics. (See Appendix B for sample questions on each of the four skill tests.)

Applied Mathematics

The Applied Mathematics skill is an employee's skill in applying mathematical reasoning and problem-solving techniques in work-related problems. Theoretical aspects of algebra and geometry, such as manipulation of formulas or developing proofs, are not required. This means that although students who have taken Algebra may find that helpful in solving some of the problems, it is not required. Also, students use a calculator and a sheet of formulas (as they would in the workplace) to answer the questions.

In Applied Mathematics, most Ohio students scored toward the middle range of scores — at Level 4 (25 percent), Level 5 (29 percent), or Level 6 (21 percent). Table 4 shows the proportion of Ohio students scoring at or above each level.

TABLE 4 REQUIREMENTS FOR THE APPLIED MATHEMATICS SKILL IN SPECIFIC OCCUPATIONS (with the proportion of Ohio students scoring at or above each level)



Avionics Technician
Department Manager
Electrical Engineer
Industrial Engineer

Instrument Mechanic
Nurse
Mechanical Drafter

Administrative Assistant
Computer Operator
Diesel Mechanic
Maintenance Mechanic
Numerical Control Machine Operator
Secretary

Customer Service Representative
Janitor
Machine Operator I
Plastics Fabricator

Counter Supervisor
Industrial Truck Operator
Industrial Cleaner
Laborer
Shipping Order Clerk

Reading for Information

The Reading for Information skill involves reading and understanding work-related information. It ranges from reading short, simple reading material with elementary vocabulary, such as straightforward memos or instructions, to very detailed material, such as excerpts from regulatory and legal documents in which employees must apply general principles to new and somewhat dissimilar situations. Interpretation of literature and poetry is not included.

In Reading for Information, most Ohio seniors scored at Level 4 (33 percent), Level 5 (32 percent), or Level 6 (22 percent). Table 5 shows the proportion of Ohio students scoring at or above each level.

TABLE 5 REQUIREMENTS FOR THE READING FOR INFORMATION SKILL IN SPECIFIC OCCUPATIONS (with the proportion of Ohio students scoring at or above each level)

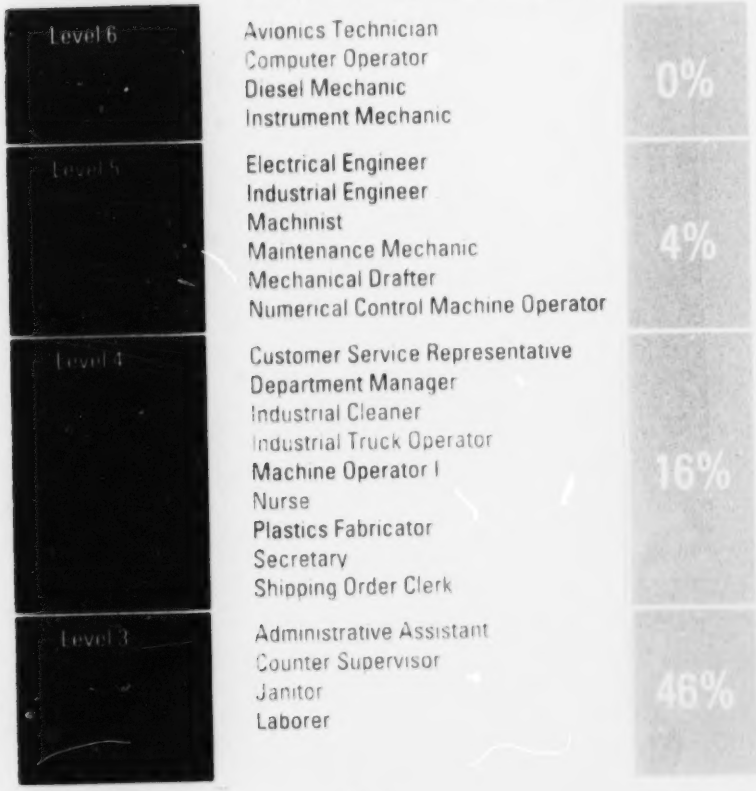
Avionics Technician Electrical Engineer Lawyer OSHA Inspector	4%
Administrative Assistant Department Manager Nurse Instrument Mechanic Industrial Engineer	22%
Computer Operator Customer Service Representative Diesel Mechanic Maintenance Mechanic Mechanical Drafter Secretary	55%
Industrial Cleaner Industrial Truck Operator Janitor Machine Operator I Plastics Fabricator Laborer	81%
Counter Supervisor Shipping Order Clerk	96%

Applied Technology

The Applied Technology assessment measures the examinee's skill in solving problems of a technological nature. The content covers the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics as they apply to machines and equipment found in the workplace. The emphasis is on identifying relevant aspects of problems, analyzing and ordering those aspects, and applying existing materials or methods to new situations. Neither previous knowledge of specific technological systems nor mathematical calculation is required.

As noted above, most Ohio high school seniors have not taken course work that covers this information since their last general science course, often in seventh or eighth grade. Consequently, the students' poor performance on this assessment is not unexpected. Most students performed below Level 3 in Applied Technology (54 percent), with an additional 30 percent scoring at Level 3. Table 6 shows the proportion of Ohio students scoring at or above each level.

TABLE 6 REQUIREMENTS FOR THE APPLIED TECHNOLOGY SKILL IN SPECIFIC OCCUPATIONS (with the proportion of Ohio students scoring at or above each level)

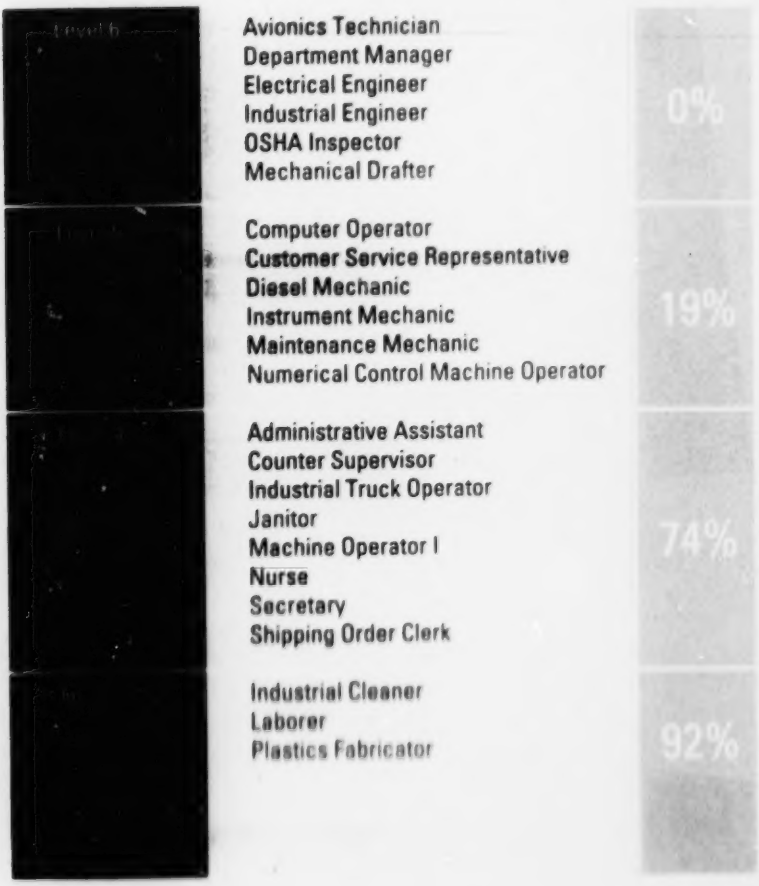


Locating Information

The Locating Information skill involves using information presented in workplace graphics such as diagrams, floor plans, tables, forms, graphs, charts, and instrument gauges. Examinees are asked to locate, insert, compare, and summarize information in one graphic or in a group of related graphics. At the highest level, examinees are asked to make decisions and draw conclusions based on information contained in one or more graphics. Mathematical calculations are not required.

Most Ohio seniors performed at Level 4 (55 percent) in Locating Information, with smaller proportions (18 percent and 19 percent, respectively) scoring at Levels 3 and 5. Table 7 shows the proportion of Ohio students scoring at or above each level.

TABLE 7 REQUIREMENTS FOR THE LOCATING INFORMATION SKILL IN SPECIFIC OCCUPATIONS (with the proportion of Ohio students scoring at or above each level)



Skill Level Results Linked to Specific Job Clusters

Given the central focus on this initiative – *i.e., to what extent do students graduating from Ohio's public schools possess the skills needed for successful entry into, and potential advancement through, the present and future workplace* – it seems most appropriate to compare students' scores to the profiles of the types of occupations to which they aspire — and that will provide job opportunities in the years ahead. This concern with measuring the entire extent of students' performance, rather than simply determining how many students meet a minimum level, is consistent with Ohio's goals for achieving high performance schools and businesses. It is also consistent with recognizing the wide variation in skill requirement for different jobs. A single standard will not meet the needs of every job or of every student aspiring to have that job.

In Work Keys, students' performance is often described in terms of the percentage of jobs for which they would qualify. Most commonly, two standards are considered: the level at which a student would qualify for 50 percent of the jobs and the level at which the student would qualify for 80 percent of the jobs. Obviously, the student who qualifies for a greater percentage of the jobs will have more choices in the job market.

In keeping with Ohio's commitment to raising expectations for student performance, the Ohio Skill Gap Initiative used the higher of the two skill level requirements — the 80 percent standard — as the primary indicator of students' future success in each job cluster. Figure 1 shows the percentage of Ohio high school seniors in the sample who meet or exceed the skill requirements in each skill area for 80 percent of the profiled jobs in each of five job clusters.

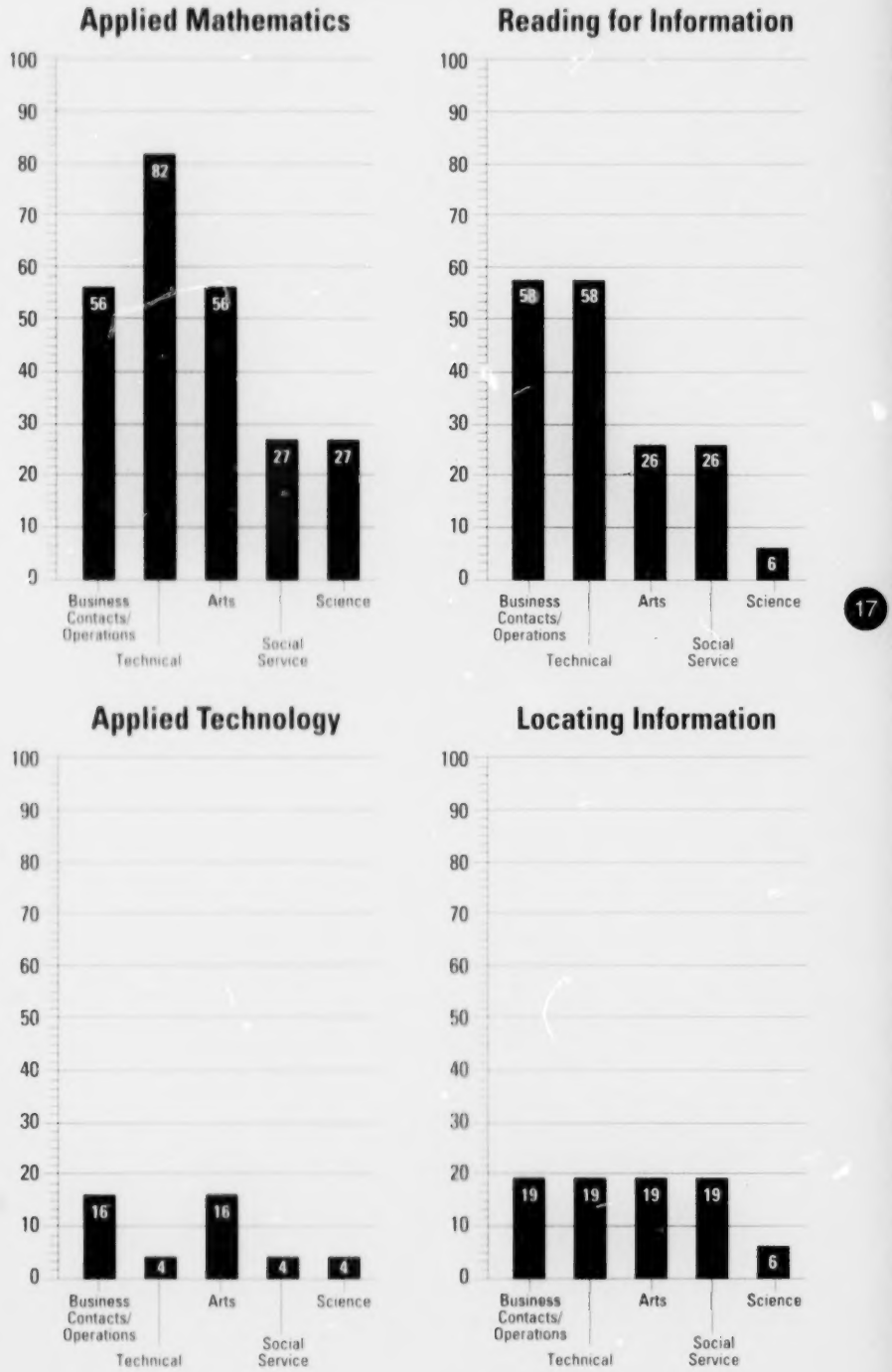
In Applied Mathematics, 82 percent of the students tested meet the required skill levels for the Technical job cluster, and 56 percent meet the skill levels required by the Business Contact/Operations and Arts job clusters. For the Science and Social Service job clusters, 27 percent meet the 80 percent requirement.

In Reading for Information, 58 percent of the students who were tested possess skill levels needed for skilled entry-level jobs in the Business Contact/Operations and Technical job clusters. For other job clusters, the percentages are lower—26 percent for Social Service and Arts, and only 6 percent for Science.

Much lower percentages of students are sufficiently skilled in Applied Technology and Locating Information. In fact, most Ohio students who were tested did not attain the skill levels in Applied Technology needed for even the Business Contact/Operations cluster, which requires the lowest skill levels of all the job clusters.

It is evident from these data that the skill gap is greatest for the Science and Social Service job clusters. Most of the training programs and entry-level jobs in these clusters require skill levels beyond those attained by the Ohio students who were tested.

FIGURE 1 PROPORTION OF OHIO STUDENTS WHO MEET OR EXCEED THE SKILL REQUIREMENTS FOR 80 PERCENT OF THE PROFILED JOBS



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Joint Effect of Multiple Skill Requirements

Employers do not hire individuals based on single, isolated skills. Rather, they look for employees who meet their skill requirements in many, if not all, skill areas.

The method by which Ohio student information was collected, with each student assessed in only one skill area, does not allow direct calculation of the effect of requiring students to meet the profile in multiple skill areas. However, ACT's database of assessment information can be used to provide an estimate of how Ohio students meet employers' multiple skill requirements. (See Appendix A for an explanation of how this estimate was established.)

Given the information available, about one Ohio high school senior in every 14 — or 7 percent — could meet the average profile across the four skill areas. Because, as expected, Ohio seniors did not perform well on the Applied Technology assessment, this estimation was also *made without consideration of that skill area.* If only the other three skill areas are considered, the proportion of Ohio seniors meeting employers' multiple skill requirements doubles to about 14 percent. *What this means is that 14* percent *of the seniors could meet the profile for Applied Mathematics, Reading for Information and Locating Information that was established in this study.*

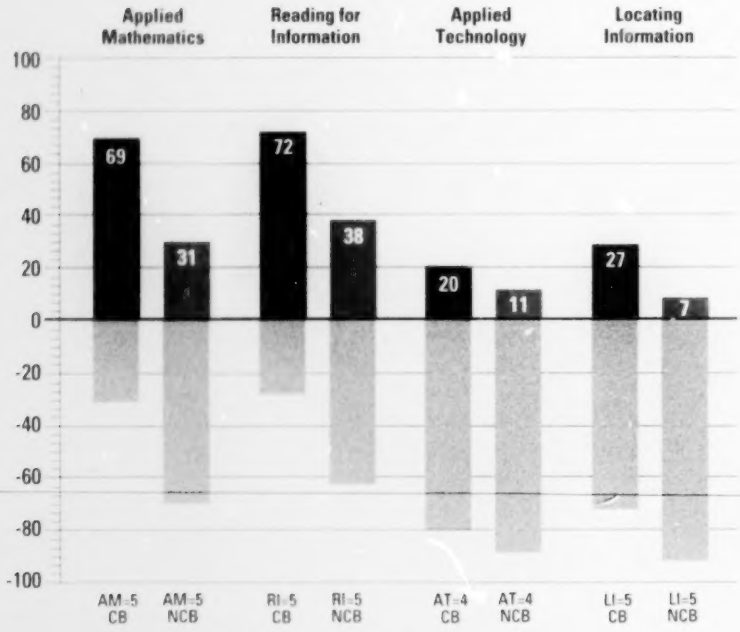
College Bound and Non-college Bound Students

All students participating in the Ohio Skill Gap Initiative were asked to mark on their answer documents whether they were in a college-bound, general, or vocational curriculum. However, providing this information was optional and about one third of all students did not provide a response. Of the remainder, about 70 percent indicated that they were in a college-bound curriculum.

Test scores of those indicating that they were college-bound were placed in one group, and scores of those indicating that they were in general or vocational curriculum in another. Of course, many students in general and vocational curricula go on to postsecondary education, and the overall percentage of students indicating that they were in a college-bound program is higher than the percentage likely to go on to college. The following analysis should be interpreted in light of this information.

In Figure 2, both groups of students are compared with the occupational profile identified in this study. Most of the college-bound students can meet the Ohio skill level requirements in Applied Mathematics and Reading for Information. For example, the first bar represents 100 percent of the college bound (CB) students and is placed so that the 0 percent line identifies those who can meet an Applied Mathematics level of 5 (AM=5) as above the line and those who cannot as below the line.

FIGURE 2 COMPARISON OF COLLEGE-BOUND (CB) AND NON COLLEGE-BOUND (NCB) OHIO SENIORS TO THE OHIO SKILL LEVEL REQUIREMENTS*



* Non college-bound seniors include vocational students and students in the general track.

For both Applied Mathematics and Reading for Information, about 70 percent of these students are above the line (i.e., they meet that criterion), while approximately 30 percent are not. Note that the college-bound students are represented in the left-hand bar of each pair, while the non college-bound (NCB) students are represented in the right-hand bar. In the case of Applied Mathematics and Reading for Information, about 30 percent of the non college-bound students can meet this same standard (AM=5), while about 70 percent cannot.

Far fewer college-bound students can meet the Ohio profiles in Applied Technology and Locating Information. Just less than 30 percent of college-bound students can meet the Locating Information profile, while only 20 percent can meet the profile in Applied Technology. In contrast, only 11 percent of non college-bound students can meet either of these profiles.

Clearly, more college-bound than non college-bound students can meet the Ohio profiles. However, it should be noted that fewer than 50 percent of either group of students can meet the profile in 6 of the 8 comparisons shown. Only for the college-bound students in Applied Mathematics and Reading for Information skill areas can more than 50 percent meet these skill levels — and these students are not generally planning to take the kinds of jobs for which the skill levels were established. In every other area, fewer than half of the students (in most cases far fewer) can meet the skill levels.

Urban, Suburban, and Rural Schools

Measurable differences occurred in the average scores of Ohio seniors from urban, suburban and rural high schools. Students in urban settings consistently scored the lowest. The average scores of suburban students were only marginally higher than those of their counterparts in rural schools. The differences were somewhat smaller in reading than in the other areas.

One way to compare the performance of urban, rural, and suburban students is to determine what percentage of students in each group performed at the skill levels typically required for successful employment. This was done by averaging the skill levels required by 80 percent of the job opportunities in each of the five job clusters identified in the study. Based on all five job clusters, the average 80 percent requirements for the four skill areas are:

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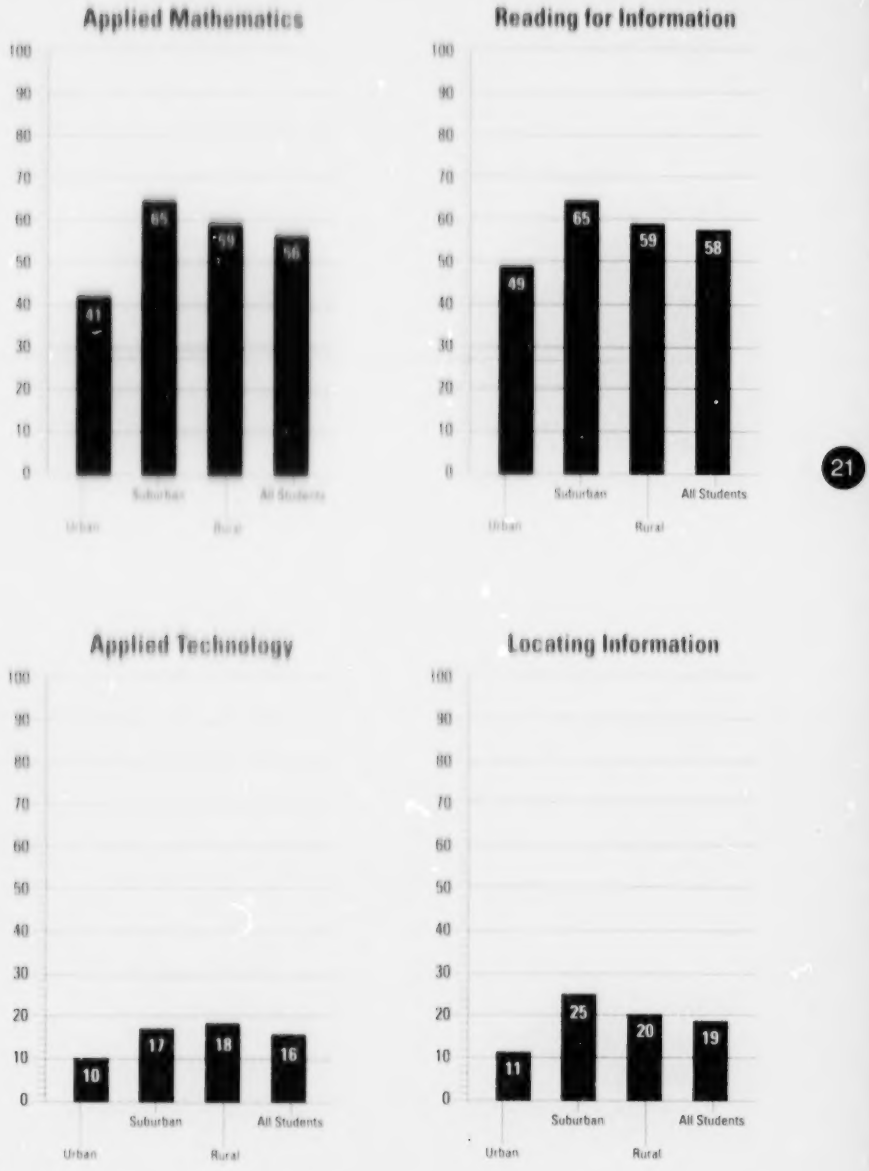
Applied Mathematics	Level 5
Reading for Information	Level 5
Applied Technology	Level 4
Locating Information	Level 5

Comparing the performance of urban, suburban, and rural students in meeting these average 80 percent requirements indicates lower performance in each skill area by students educated in urban schools. The greatest disparity between urban schools and suburban/rural schools is in Applied Mathematics.

FIGURE 3 PERCENTAGES OF OHIO STUDENTS MEETING THE AVERAGE 30% REQUIREMENTS BY SCHOOL TYPE



CONCLUSIONS

Closing Ohio's Skill Gap

When linked to labor market information from the Ohio Bureau of Employment Services, the Work Keys skill level data for 14,474 Ohio high school seniors provide a clearer picture of Ohio's skill gap and its potential effects. Several important discoveries resulted from the study:

- Ohio has a significant skill gap. In each skill area assessed, a substantial percentage of students are underprepared for learning and performing most skilled entry-level jobs. This evidence of a skill gap is further supported by the percentage of Ohio students who enter the higher education system requiring remedial courses.

- In general, college-bound students are well prepared for jobs requiring a high school education. On the other hand, the students who are not college-bound are not very well prepared for those jobs. Keeping in mind that 20 percent to 25 percent of the students included in this study will be taking jobs that require 4 or more years of higher education, jobs that were not included in the occupational clusters, this situation may be somewhat worse than the data show.

- Skill levels required by different job clusters vary widely. For example, most entry-level jobs in scientific fields call for much higher skill levels than do most entry-level clerical or customer service jobs.

- The skill gap is greatest where the skill is not included in the students' curriculum — in Applied Technology and, to a lesser extent, in Locating Information. Ohio's weakest performance was in locating information presented in workplace graphics and solving work-related problems of a technological nature. In each of these two skill areas, Ohio students in the sample demonstrated skill levels lower than those required by most of the jobs that were included in the study.

- There are measurable, although not dramatic, differences in the skill levels of students from urban, suburban, and rural schools. Although the skill gap was evident in all types of schools, students in urban schools consistently scored lower than students in suburban and rural schools. Differences between the scores of suburban and rural students exist, but are not significant.

Recommendations: Actions Designed to Close Ohio's Skill Gap

One of the primary missions of Ohio's schools is to ensure that students graduate with the knowledge and skills they will need to live fulfilling, productive lives. Yet, this analysis confirms that many of today's high school seniors do not have the academic knowledge and skills they need to get good jobs, to enter first-rate vocational training programs, or to earn degrees from a two- or four-year college.

While schools play an important part in helping our young people prepare to become productive adults, they cannot be expected to do the job alone. Businesses, parents and community leaders must anticipate future needs and communicate those needs to students, teachers, and school administrators. They must continue to be involved to help educators with this critical learning process.

In this context, one of the principal objectives of the Ohio Skill Gap Initiative is to focus employers, educators, parents, and public officials on actions that will be required to close Ohio's skill gap. And this purpose can only be satisfied if all stakeholders understand that learning is a continuing process – one that does not end with graduation from high school or college.

The Ohio Business Roundtable and Ohio Department of Education join in advancing the following recommendations for future action:

Recommended actions for educators:

- Continue the drive for higher academic standards, more challenging tests, and increased accountability. Expect high academic standards that prepare students for success in school, the workplace, and life. Focus on results — measuring and reporting student and system performance so that students, teachers, parents, and the public can understand and act on the information.

- Ensure that all students have strong academic skills and opportunities for work experience. Create new opportunities for work-based learning — through School-to-Work, internships, apprenticeships, mentorships, cooperative education, and vocational education — that help students develop and exercise complex problem-solving skills, test real-world working conditions, appreciate the nature of work, and strengthen personal connections to employers, adult mentors, and career pathways. Prepare students for both college and the workplace. Integrate both academic and occupational objectives into classes at appropriate levels.

- Continue to monitor student performance on skill-based assessments, such as those in the Work Keys system, on both a statewide and community-by-community basis. Establish goals that address ***what*** skills students need to learn so they are prepared for their futures, and to ***what level*** they must learn these skills. Urge public officials to include skill-based assessments in statewide proficiency testing programs.

- Invite employers, parents, and community leaders to become involved in the identification of academic and skill standards. Expand the dialogue between employers and educators — particularly as it relates to workforce skill requirements. Build sustainable institutional connections between employers and educators — creating and sustaining systems of organized access for young people to quality jobs and training, new labor market practices, and collaboratives.

- Provide teachers and administrators with professional development opportunities to ensure that all students are taught by teachers who have the knowledge, skill, and commitment to teach. Help teachers understand and experience workplace needs and opportunities.

- Place greater emphasis on learning the physical sciences in a manner that allows students to apply their knowledge to real-world settings.

Recommended actions for employers:

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- Promote higher standards for all students in core academic subjects and continue to press for heightened accountability for results. Advise and reinforce educators in implementing more demanding graduation requirements, a new high-stakes graduation test, and school district report cards — recognizing that true accountability not only has measurement and reporting, but consequences as well.

- Send clear and credible messages about your skill needs. Specify these needs in terms of standards, such as the Work Keys skill levels, that are objective, quantifiable, and readily understood by educators and students.

- Incorporate these standards into your own recruitment, hiring, and certification requirements – recognizing that students and educators will not believe that building skills is a key factor in getting a job, and in being able to perform that job, unless they can see a direct link between preparation and employment. To this end, request as part of the hiring process that students furnish copies of their high school transcripts and, if available, a career passport that demonstrates their competencies, skills, accomplishments, and other credentials.

- Assist schools, colleges, and universities in developing integrated curricula — courses that will prepare students for good jobs that are, or will be, available in your community.

- Offer internships and other professional development opportunities for educators, administrators, and counselors. Give them firsthand exposure to the workplace through job shadowing and internships that provide on-the-job experience that will enhance their knowledge and skills.

- Build partnerships with schools, colleges, and universities and work with other employers to provide students with mentors through apprenticeship programs, Tech Prep internships, and other School-to-Work initiatives.

- Provide ongoing employee training and continually enhance skills for the high-performance workplace.

Recommended actions for parents and communities:

- Let educators, employers, and public officials know that you support initiatives that raise student achievement and prepare every student for future employment and further education. Become an advocate for integrated learning that links academic and occupational instruction to help students understand how knowledge and skills are used in real life. Demand that your schools expose students to rapidly changing technologies through challenging academic curricula and innovative approaches to instruction.

- Let your children know that learning is a lifelong process — and that their performance in school and college will make a difference in their career opportunities. Work with them as they develop an Individual Career Plan (ICP) and/or Career Passport. Talk with them about their plans for the future. Help them develop realistic expectations about specific jobs and careers. Make sure they know about the wide range of career options they can pursue — and about the knowledge and skills that they will need to be successful.

- Work with your children's teachers and guidance counselors to ensure that students have strong academic skills and education plans reflecting their career goals and expectations. Make sure that academic and career objectives are integrated into their classes. Become familiar with school guidance and counseling programs.

Recommended actions for public officials:

- Use the findings in this report to inform and evaluate the definition of the new statewide graduation competencies required under Senate Bill 55.
- Use this report — and other relevant data — to inform and evaluate their efforts to articulate exit-level/college-readiness competencies for Ohio's high school seniors.
- Continue and invigorate the state's Urban Schools Initiative, particularly as it relates to standards-based education reforms.
- Join with leaders in Ohio's education community in creating community-based forums to discuss the implications of the new school district and building report cards and the skill gap for individual school communities. Help educators, parents, employers, and community leaders agree on school improvement strategies that address how they will work together to enhance academic achievement and close the skill gap.
- Enact policies and target resources to create and build the capacity of school systems to close the skill gap. Ensure that state laws, regulations, and resources are aligned to support closure of the skill gap.

APPENDIX A:

Sampling Methodology for the Student Assessment

To obtain estimates of the skills of Ohio's high school population, a sample of students was selected. During November 1996, each student selected for the sample took one of the four Work Keys tests: Reading for Information, Applied Mathematics, Applied Technology, and Locating Information. The scores from the sample were used to estimate the population values.

The sample was a stratified cluster sample, which means that sampling is done at the school level rather than the student level. Stratification refers to the act of dividing the population into homogeneous groups (or strata) and sampling from each group separately. In this case, the stratification variables are type of school and size of school.

The types of school defined for this sample were urban, suburban, and rural. The differentiation between suburban and rural schools was based on where the school was located, using definitions provided by the U.S. Bureau of the Census. Urban schools came from Ohio's 21 urban school districts, as defined by the Ohio Department of Education. None of the selected schools was included in more than one category.

Size of school was chosen as a stratification variable for technical reasons. Since school was our sampling unit, the number of students in the sample was random. This introduced a small element of bias into the estimates. To reduce this bias, some control over the sample size was necessary. To maintain this control, schools were divided into groups based on size, and samples were drawn from each group. In this case, the urban schools were divided into two categories — large and small — while the other two types were divided into three size categories. Consequently, there were small, medium-sized and large schools included in the sample.

Once the strata had been defined, each school was classified into one of the strata. The source of the school names, sizes, and types was a database of all schools in the United States and Canada purchased by ACT from Market Data Retrieval. Only public schools were included in the sample.

Random selection was done within each strata, with the number selected from each strata proportional to the total number of schools within the strata. Some oversampling was done in the urban school strata, in order to get enough schools from three specific areas of interest — Cuyahoga, Franklin and Hamilton Counties. The total number of schools selected — 255 — allowed for some refusal at the initial recruitment stage and some attrition once the schools had agreed to participate.

A joint letter was sent from the Ohio Department of Education and the Ohio Business Roundtable to both the school principal and the superintendent of the school district explaining the purpose and details of the study. The letter informed the principal that he or she might be contacted to participate in the study. Approximately one week later, ACT personnel started calling the schools to see if they were willing to participate. Calling continued for about 10 days until enough schools had agreed. Each school was contacted at least once. In some cases, however, no follow-up calls were made, once enough schools in that strata had agreed to participate.

Of the 157 schools that agreed to test, 143 schools actually tested and sent back materials. The remaining 14 sent back all materials without testing.

For the schools that did return data, each was checked to verify that the number of students tested was approximately equal to the number of tests expected. Any school that did not return at least 80 percent of the number sent was called and asked about the discrepancy. In some cases, the reason given was such that the data are still usable. The reasons ranged from schools testing a random sample of their students to schools that tested after a large snowstorm. In any case, where the reason indicated that the data would be suspect, such as significant student refusal, or if no explanation was given, the data from that school were deleted from the analysis.

The final total of schools providing usable data was 119. Most of the schools deleted for the analysis came from the urban strata. Consequently, there are now fewer students from these strata than expected. To ameliorate this flaw, we differentially weighted the scores of the students, using the number observed in the sample, and the number expected to be in the sample.

Weighting

Weighting is a procedure used to adjust for differential response rates. For example, suppose we are taking a sample of 100 people and we expect to get 50 men and 50 women. In the sample, we observe 60 men and 40 women. To adjust our sample to more closely reflect the population, we will put more weight on the women's responses and less weight on the men's responses. In this case, if we weight each man's response by 5/6 and each woman's response by 5/4, the effective weight of the men and women is 50 percent each. Weighting is sometimes referred to as post-stratification.

For the Ohio Skill Gap Initiative, there are two stages of weights. One is for non-response at the school level, and the other is for non-response at the stratum level. The first weight for school i, call it $W_1(i)$, is the ratio of the number of students at the school to the number of students who took the test. In this way, the scores achieved by the students who took the test represent all of the students at the school. Schools that tested a smaller percentage of their students receive larger weights.

The second weight for school i, call it $W_2(i)$ is the ratio of the number of schools in a stratum to the number of school that tested in that stratum. In this fashion, strata where there was a low response rate will receive a higher weight. This allows the sample to represent more closely the population of interest. In our study, schools in the urban strata receive higher weights, while those in the rural strata receive relatively lower weights.

Precision

One of the things that must be kept in mind is that the numbers presented in the report are estimates of the true population values, not the exact values themselves. Because we are dealing with a sample, these estimates are subject to error, which can be quantified. Many of the statements made in the data analysis section concern proportions. We have calculated the estimates of the precision for various proportions and these results are listed in Table 8.

TABLE 8 PRECISION ESTIMATES FOR THE OHIO SKILL GAP INITIATIVE

Test	Coefficient of Variation of Sample Size	Median and Range of Standard Deviation of Proportions	Effective Sample Size
Applied Mathematics	.02	.0161 (.0112 - .0198)	656
Reading for Information	.02	.0126 (.0075 - .0186)	1111
Applied Technology	.02	.0145 (.0079 - .0175)	816
Locating Information	.02	.0123 (.0065 - .0162)	1217

The coefficient of variation of sample size gives the extent to which control was maintained over the sample size. Since the selection of school is random, the total sample size is also random. This can lead to bias for the usual statistics. If the coefficient of variation of sample size is small (less than .1), then this bias will be small. For our sample, the coefficient of variation is considerably smaller than .1, indicating that bias is not a problem.

The second set of values are the estimated standard errors. For example, the first line says that the median value for the Reading for Information test is .0126. This is based on the calculation of estimated standard deviations for proportions with probabilities .10, .25, .50, .75, and .90. In general, the standard deviations are largest when the proportion is close to .5 and smallest when the proportion is near 0 or 1.

Our original target for precision was to estimate all proportions to within .05 with probability .95. This is equivalent to a standard deviation of .025. As can be seen in the table, the estimated standard deviations are smaller than the target value. To guide the interpretation of the proportions, keep in mind that about two thirds of the time, the actual proportion will be within one standard deviation of the estimated value. About 95 percent of the time, it will be within two standard deviations of the estimated value.

The final column in Table 8 is the effective sample size. This is the size required for a random sample to achieve equivalent precision as the sample observed. Our target for this value is 400. The smallest effective sample size is more than 600, indicating that the sample sizes are sufficient to reach accurate conclusions.

Estimating the Joint Effect of Multiple Skill Requirements

Each Ohio student took only one test, but what we need is an estimate of the joint probability of scores on all four tests. This could be obtained if we knew the conditional probability of obtaining a set of scores given a score on one of the other four tests. For example, we would like to know the conditional probability of getting a 4 on the Reading for Information test, a 4 on the Locating Information test, and a 4 on the Applied Mathematics test, conditional on a score of 4 on the Applied Technology test.

To get estimates of these quantities, we made use of ACT's database of Work Keys scores. We used the conditional probabilities from this database to get the joint probabilities for Ohio students. Note that this does not require that Ohio students have the same level of skills as the test takers whose scores are represented in the database. It only requires that the relationships between the scores are the same. In other words, it requires that students in Ohio who are scoring a 4 on Applied Technology score similarly on the other tests as the people in the database who are scoring 4 on Applied Technology. In statistical jargon, we want the conditional probabilities (not the marginal probabilities) to be the same. We looked at scores of Ohio students on the ACT exam compared to students in other states to see if this assumption is reasonable. In general, the conditional probabilities are very similar.

APPENDIX B:

Sample Questions for ACT's Work Keys Assessments

The following sample questions have been taken from the four Work Keys assessments used in the Ohio Skill Gap Initiative. Two questions — one illustrating the skills required at the lowest level (Level 3), and the other reflecting the skills required at the highest level (Level 6 or 7 depending on the skill area) — are presented for each of the four assessments.

The answers for these eight sample questions are provided at the bottom on this page.

Applied Mathematics

Level 3 Sample Item

1. In your job as a cashier, a customer gives you a $20 bill to pay for a can of coffee that costs $3.84. How much change should you give back?

   A. $15.26
   B. $16.16
   C. $16.26
   D. $16.84
   E. $17.16

B

Level 7 Sample Item

1. The farm where you just started working has a cylindrical oil tank that is 2.5 feet across on the inside. The depth of the oil in the tank is 2 feet. If 1 cubic foot of space holds 7.48 gallons, about how many gallons of oil are left in the tank?

   A. 37
   B. 59
   C. 73
   D. 230
   E. 240

ANSWERS FOR SAMPLE QUESTIONS

Applied Mathematics: Level 3 (B); Level 7 (C)
Applied Technology: Level 3 (B); Level 6 (D)
Reading for Information: Level 3 (C); Level 7 (A)
Locating Information: Level 3 (B); Level 6 (C)

Reading for Information

Level 3 Sample Item

MEMO

To: All businesses in Logan City Mall
From: Philip Charles, Logan City Mall Manager
Re: New garbage collection rules

Logan City Mall has hired a new garbage collection company. Speedy Sanitation, Inc. will be collecting garbage from all businesses starting next Monday. Collection days will not change. The pick-up time will be one hour later.

Each business will be given one blue garbage can to use. Each business may ask for 2 extra garbage cans. You may have a total of 3 garbage cans. You will not need yellow collection tags anymore. Full garbage cans must weigh less than 30 pounds. Put your garbage in bags before putting it in the garbage cans. Put your garbage cans in the alley behind your business's back door.

B

1. Starting next Monday, what is the greatest number of garbage cans a business is allowed to have?

   A. 1
   B. 2
   C. 3
   D. 13
   E. 30

Reading for Information

Level 7 Sample Item

Section 108

a) Notwithstanding the provisions of Section 106, it is not an infringement of copyright for a library or archive, or any of its employees acting within the scope of their employment, to reproduce more than one copy or phonorecord of a work, or to distribute such copy or phonorecord under the conditions specified by this section if

1) the reproduction or distribution is made without any purpose of direct or indirect commercial advantage;

2) the collections of the library or archive are (i) open to the public, or (ii) available not only to researchers affiliated with the library or archive or with the institution of which it is a part, but also to other persons doing research in a specialized field; and

3) the reproduction or distribution of the work includes a notice of copyright.

b) The rights of reproduction and distribution under this section apply to a copy or phonorecord of an unpublished work duplicated in facsimile form solely for purposes of preservation and security, or for deposit for research use in another library or archive of the type described by clause (2) of subsection (a), if the copy or phonorecord reproduced is currently in the collections of that library or archive.

c) The right of reproduction under this section applies to a copy or phonorecord of a published work duplicated in facsimile form solely for the purpose of replacement of a copy or phonorecord that is damaged, deteriorating, lost, or stolen, if the library or archive has, after a reasonable effort, determined that an unused replacement can not be obtained at fair cost.

1. Based on information above, which of the following conditions would prohibit a city employee from photocopying an unpublished manuscript?

   A. If the photocopy is to be sent to a public research library that does not have a copy of the manuscript
   B. If the photocopy would not produce any income for the city library
   C. If the city library's original copy of the manuscript is in danger of damage through use
   D. If the city library is accessible to any and all citizens and researchers
   E. If the employee makes only one copy of the manuscript as a secure transcription

Applied Technology

Level 3 Sample Item

You are building a greenhouse like the one shown in Figure 1 for a local nursery. The owners specified that the greenhouse should have automatic vents, which will open when the temperature in the greenhouse gets too high for the plants. Figure 2 shows the floor plan of the greenhouse.

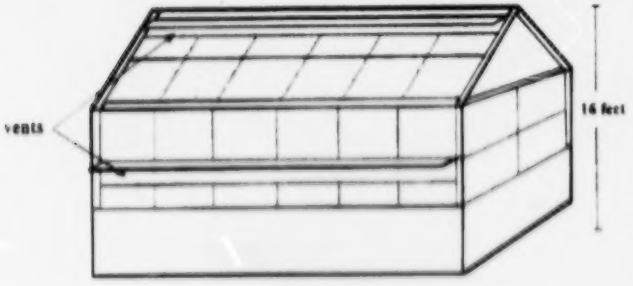


Figure 1

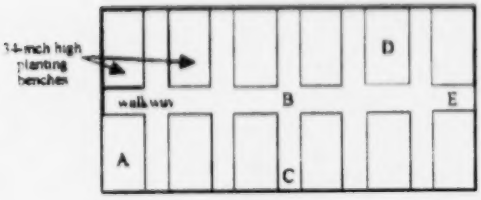


Figure 2

B

1. A thermostat will control the opening and closing of the automatic vents. It is a temperature-sensitive device that can be set to activate when the air around it reaches a certain temperature. The owners of the greenhouse want the vents to open when the air around the majority of the plants reaches 90° F. At what height and location in Figure 2 should you install the thermostat so it gives the desired results?

   A. About 4 feet from the floor at location A
   B. About 4 feet from the floor at location B
   C. About 8 feet from the floor at location C
   D. About 8 feet from the floor at location D
   E. Near the peak of the roof at location E

Applied Technology

Level 6 Sample Item

The garage where you work is equipped with a hydraulic lift like the one shown below. This lift raises cars off the floor so they can be more easily serviced.

An air compressor capable of generating pressures of 120 pounds per square inch (psi) powers the lift. The air regulator releases a steady amount of air pressure (usually 30 to 40 psi) and the control valve directs the flow of that air through the lines. Pushing the control valve forward (as shown in the figure) allows air into the lines, raising the lift. Moving the valve to the middle position seals the line so no air can escape. Pulling the valve back releases air from the line, lowering the lift. The air from the compressor exerts a force on a tank of hydraulic fluid, which in turn transmits this force to the bottom of the lifting piston.

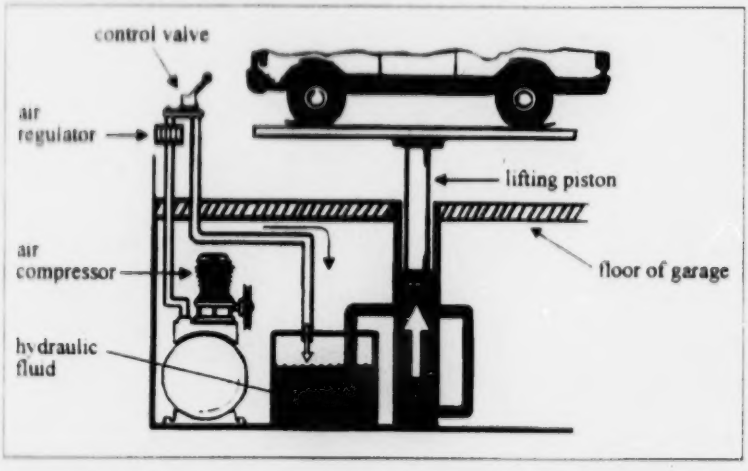


Figure adapted from *Principles of Technology Teacher's Guide*, Year 1, Unit 7, *Force Transformers* (Waco, TX: Center for Occupational Research and Development, 1991), 94. Used with permission.

1. You have been working on a car up on the lift for about an hour. When you raised the car, the lift worked normally, but now the lifting piston has begun to creep down. You check the control valve and it is fine. Also, there is no hydraulic fluid on the garage floor or in the lift pit below the garage floor. The next thing you should check to determine the problem is the:

   A. air compressor
   B. air regulator
   C. air line between the compressor and the control valve
   D. air line between the control valve and the hydraulic fluid reservoir
   E. line between the hydraulic fluid reservoir and the lifting piston

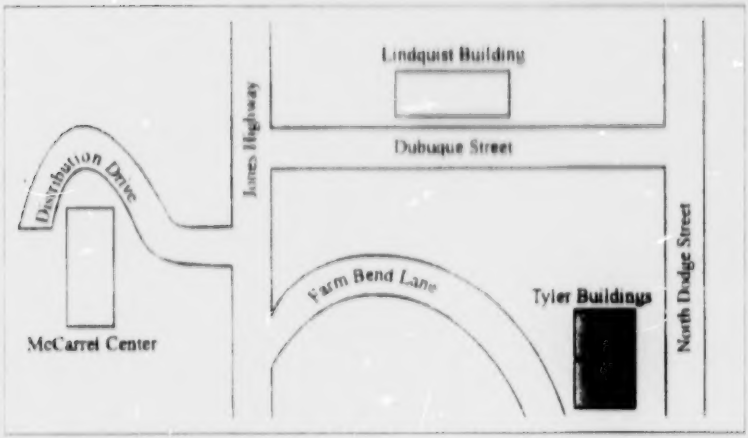
Locating Information

Level 3 Sample Item

You work for an overnight mail service.

1. You must deliver a package to the Lindquist Building. According to the following map, on what street is the Lindquist Building located?

   A. Distribution Drive
   B. Dubuque Street
   C. Farm Bend Lane
   D. Lindquist Street
   E. North Dodge Street



B

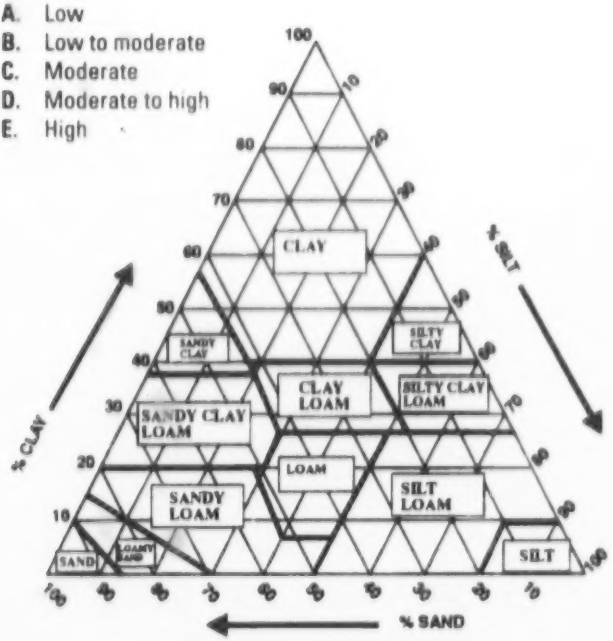
Locating Information

Level 6 Sample Item

You are a road contractor and you have analyzed a soil that you want to use for road fill.

1. Your analysis shows that the soil contains 15% sand, 65% silt, and 20% clay. You need to know what the shrink-swell potential is for the soil because it will affect the durability of the road. Based on the following diagram and table, what is the shrink-swell potential at a 30-inch depth for this soil?

   A. Low
   B. Low to moderate
   C. Moderate
   D. Moderate to high
   E. High



Soil name	Texture class	Depth (inches)	Shrink-swell potential
Sarpy	sandy loam	0-7 7-60	low low to moderate
Kennebec	silt loam	0-38 38-60	moderate low to moderate
Colo	silty clay loam	0-31 31-60	high high
Blend	silty clay	0-17 17-29 29-60	high moderate to high high
Nevin	clay loam	0-28 28-48 48-60	moderate to high moderate moderate
Kenmoor	loamy sand	0-24 24-60	low high

APPENDIX C:

Ohio High Schools Participating in the Ohio Skill Gap Initiative

Adena High School, Frankfort
Allen East High School, Lafayette
Amanda-Clearcreek High School, Groveport
Anna Jr/Sr High School
Ayersville High School, Defiance
Barberton High School
Barnesville High School
Bealleville High School
Beaver Local High School, Lisbon
Bedford High School
Bellaire High School
Bellevue High School
Belmont High School, Dayton
Brookhaven High School, Columbus
Buckeye Local High School, Rayland
Centerville High School
Central-Hower High School, Akron
Chardon High School
Choffin Career Center, Youngstown
Clear Fork High School, Bellville
Clyde High School
Columbia High School, Columbia Station
Columbiana County Career Center, Lisbon
Columbus Alternative High School
Cuyahoga Heights High School
Danbury Jr/Sr High School, Lakeside
Deer Park High School, Cincinnati
Diamond Oaks Career Development Campus, Cincinnati
East High School, Youngstown
East High School, Akron
Eastland Career Center, Groveport
Eaton High School
Edgewood High School, Trenton
Edon High School
Elgin High School, Marion
Elyria High School
Evergreen High School, Metamora
Fairfield Career Center, Carroll
Finneytown High School, Cincinnati
Fort Loramie High School
Franklin Heights High School, Columbus
Fremont Ross High School
Fort Frye Jr/Sr High School, Beverly
Gallia Academy High School, Gallipolis
Garfield Alternative Education Center, Middletown
Garfield High School, Garfieldville
Geneva Secondary School
Gahanna-Lincoln High School
Girard High School
Grand Valley High School, Orwell
Grove City High School
Guernsey Noble Career Center, Senecaville
Hamilton High School
Hamilton Township High School
Hayes Technical High School, Grove City
Indian Hill High School, Cincinnati
John F. Kennedy High School, Cleveland
John Marshall High School, Cleveland
Kenmore High School, Akron
Keystone High School, Lagrange
Labrae High School, Leavittsburg
Lake Senior High School, Uniontown
Laurel Oaks Career Development Campus, Wilmington
Libbey High School, Toledo
Lima Alternative High School
Lincoln-West High School, Cleveland
Logan Senior High School
Louisville Senior High School
Madison Plains High School, London
Malvern Jr/Sr High School
Margaretta High School, Castalia
Marion-Franklin High School, Columbus
Martin Luther King High School, Cleveland
Maumee High School
Max S. Hayes Vocational School, Cleveland
Mayfield High School, Mayfield Village
Maysville High School, Zanesville
Meigs High School, Pomeroy

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Miamisburg High School
Milton Union High School, West Milton
Minford High School
Monroe Central High School, Woodsfield
New Albany High School
New London High School
New Miami Jr/Sr High School, Hamilton
New Philadelphia High School
Normandy High School, Cleveland
North Adams High School, Seaman
North Olmstead High School
Northridge High School, Johnstown
Northwest High School, McDermott
Oak Hill Jr/Sr High School
Olmstead Falls High School
Parma High School, Cleveland
Peebles High School
Philo High School
Pioneer Joint Vocational School, Shelby
Piqua High School
Polaris Career Center, Middleburg Heights
Portage Lakes Career Center, Green
Portsmouth East High School
Pymatuning Valley High School, Andover
Reading High School
Ridgedale High School, Morral
River High School, Hannibal
Rocky River High School
Scioto County Joint Vocational School District, Lucasville
Shadyside High School
Shaw High School, Cleveland
Solon High School
South Central High School, Greenwich
South High School, Cleveland
South Range High School, North Lima
South Webster High School
Southeast Career Center, Columbus
Southern Local High School, Racine
Springfield High School, Akron
Springfield High School, New Middletown
Steubenville High School
Stryker High School
Sycamore High School, Cincinnati
Teays Valley High School, Ashville
Tri-County Joint Vocational School, Nelsonville
Union High School, Chillicothe
Walnut Hills High School, Cincinnati
Warrensville Heights High School
Waterloo High School, Atwater
Wayne High School, Huber Heights
Wellington High School
Wellston High School
West High School, Columbus
West Muskingum High School, Zanesville
West Union High School
Western Hills High School, Cincinnati
Westerville North High School
Westerville South High School
Westland High School, Galloway
Whetstone High School, Columbus
White Oak Senior High School, Mowrystown
Williard High School
Woodward High School, Cincinnati
Wyoming High School
Zanesville High School

The Ohio Business Roundtable is an independent, nonpartisan organization of the chief executive officers of the state's largest and most influential business enterprises. The Roundtable's mission is to apply the knowledge, experience, and insight of its membership, working in partnership with public leaders, to solve complex problems affecting Ohio's overall economic and social vitality.

The Ohio Business Roundtable is comprised of the CEOs of the following organizations:

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The Ohio Department of Education, under the direction of the State Board of Education, is primarily responsible for public education in the State of Ohio from pre-Kindergarten through high school. The mission of the Department of Education and the Board is to ensure all Ohio students reach high levels of academic achievement, a primary key to their success as individuals, workers, and citizens.

To accomplish that mission, the Department focuses its resources and talents to assessing the academic achievement of Ohio students, reporting results to districts and communities, and providing technical support and assistance to assure improvements over time.

ACT, Inc., is a nonprofit corporation dedicated to providing "Information for Life's Transitions." ACT offers testing programs and research services that help individuals make educational and career transitions. Although perhaps best known for its college-entrance program, ACT is quickly gaining attention as well for its Work Keys® system, often called "the way to a winning workforce."

Work Keys helps employers match the skill requirements for specific jobs to the measured skills of individuals, resulting in better hiring decisions, increased productivity, and greater employee satisfaction. Work Keys is the first universal system to provide a common language whereby policymakers, labor, educators, employers, employees, students, and job seekers can all communicate in their efforts to improve the nation's workforce.

The Public-Private Partnership That Produced the Ohio Skill Gap Initiative

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For more information about
the Work Keys system, call
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Unless otherwise indicated,
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"***Knowledge & Know-How*** is a first-of-its-kind effort to identify and measure systematically the gaps between the knowledge and skills students possess today and what they will need tomorrow to perform successfully in the workplace.

The product of a partnership between the Ohio Business Roundtable and the Ohio Department of Education, it confirms that too many of our young people are unprepared for learning and performing most skilled entry-level jobs. It reminds us that education is a continuing process that does not end with graduation from high school or college.

The skill gap is one of Ohio's greatest economic challenges — one that is shared by educators, employers, parents, communities and public officials. How we address this issue — and how we act to close Ohio's skill gap — will have vast implications for the competitiveness of Ohio business, our quality of life, and Ohio's future."

Governor George V. Voinovich
State of Ohio

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